Servo and Stepper Motor Interfacing

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Objective

- Study of stepper and servo motors
- Interfacing with ATmega2560 and ARM based Firebird V robot
- Study working characteristics of steppers
- Write API for precision and speed control of a servo
- Write API for speed control of a stepper
- Investigate frequency range supported by servo
- Control 4-DOF robotic arm and write API

Completion

Tasks	Status
• Study of stepper and servo motors	Done
• Interfacing with Firebird V robot	Done
• Study working characteristics of steppers	Done
• Write API for precision and speed control of a servo	Done
• Write API for speed control of a stepper	Done
• Investigate frequency range supported by servo	Done
• Control 4-DOF robotic arm and write API	Pending

- Stepper's voltage vs. current graphs were analysed for different step modes.

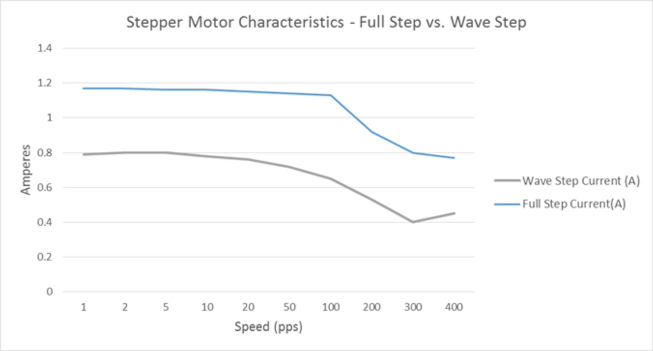
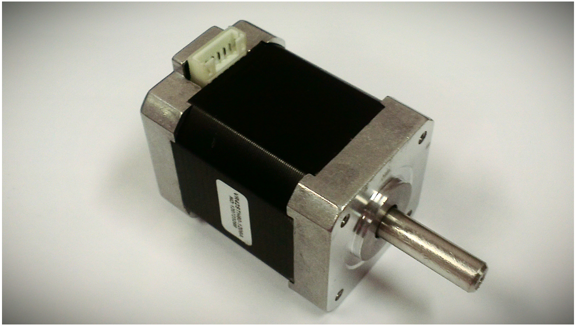


Figure : Comparison of currents in Full vs Half stepping modes

Results and Discussion

Stepper Characteristics (contd.)

- Stepper's torque at different speeds could not be measured because of the lack of reliable method and equipment to measure the static as well as dynamic torque simultaneously.



Results and Discussion

Servo Precision and Speed Control API

- Implemented with interrupts
- A 20 ms time period divided into 8 slots of 2.5 ms each
- Each used to control the on time of 3 servos with 3 channels of Timer1
- Speed is varied by linearly increasing/decreasing servo angle in calculated time

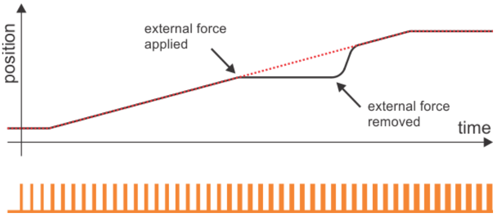


Figure : Speed control through position ramp

Results and Discussion

Stepper Speed Control API

- Implemented using timer and compare match interrupt
- A continuously running timer is used.
- Time period before next step is calculated and compare match is scheduled after that time
- Speed is varied by varying the step time delay

Results and Discussion

Servo characteristics

- Servo operating frequency $\Rightarrow$ 20 - 300 Hz
- Much more tolerant than rated range of 40 - 60 Hz
- Torque and speed output fairly constant throughout range
- Lower frequencies (5 - 15 Hz) gives low torque and jerky motion
- Servo starts heating up at higher frequencies ($>$ 300 Hz)

Features

- Simultaneous control of upto 24 servos
- Servo can be connected to any GPIO pin
- 1° precision for each servo
- Independent Speed control
- Ability to simultaneously rotate multiple servos
- Non-blocking calls - implemented in interrupts

Bugs and Limitations

- Servo tends to deviate to extreme end when changing targets near 0°
- Servo sometimes takes a fast start when told to move at a certain speed

Features and bugs

Stepper Speed Control API

Features

- Stepper can be connected to any GPIO pins even from different ports
- Upto 3 steppers can be controlled simultaneously
- Steppers can be commanded to rotate in single steps or to rotate specified number of steps at a specified speed
- Speed can be varied in motion to create speed ramps
- Non-blocking calls - implemented in interrupts

Bugs and Limitations

- Only 3 steppers can be controlled with a single timer.
- Speed ramps aren't implemented in interrupts although it is possible

Future Work

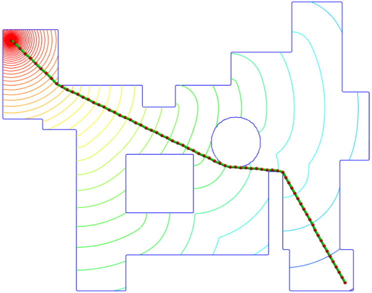
- Stepper API can be improved to implement speed ramp in interrupts
- Servo API can be used for robotic arms and humanoid robots requiring simultaneous control of multiple servos
- Resolving bugs in Servo API

B.E. Project Idea

Joel

Environment mapping and shortest path planning

- A robot examining its surroundings and building a map in memory.
- Then on further navigations to a certain destination, use the shortest path to travel to it
- Can be applied in situations or places where human exploration is limited or dangerous.



B.E. Project Idea

Vishal

Control of Wheelchair using Eye Movements

- A camera captures images.
- Sends these to a computer for processing
- Depending on pics of various eye, head movements, sends commands to controller for doing certain task

B.E. Project Idea

Vishal

Control of Wheelchair using BCI

- An electrode captures neural signals
- Sends these to a computer for processing
- Depending on peaks in signals due to various movements, sends commands to controller for doing certain task

Thank You!